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OUR NEW WAR-SHIPS.

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THE extraordinary departure which the United States has taken in naval construction since 1881, when it possessed not a single modern ship, is sufficiently remarkable to those familiar with all the steps by which it has been accomplished; and to foreigners unaccustomed to American push and energy it seems hardly comprehensible. The lack of interest in naval development in the fifteen years following the war permitted the fleet to fall into a condition of decrepitude and decay that left the United States completely out of the list of naval powers. When the popular demand for a reconstruction of the navy began to arise, shortly after this period, there seemed to be no way to meet it. Information as to progress abroad was scanty, and naval shipbuilding was apparently a lost art in this country. There had been a time, many years before, when our designers and constructors led the world. But that time had long since passed, and meanwhile naval architecture had taken such enormous strides that the expert of thirty years before was only half-equipped for the work of the period.

From this slough the navy was first extricated by the commencement, in 1883, of four steel vessels, the "Chicago," "Boston," "Atlanta," and "Dolphin." They were in every sense experimental—in their design, in the material of construction, and in the mechanics who were employed on them. It was new work, from the ground up. That they were carried to complete

success, and that they fairly represented the progress of ship-building of the period, though not in advance of it, are facts remarkably creditable to all who had a hand in their construction.

The next ships laid down for the navy were begun in 1887, and comprised the "Newark," "Charleston," "Baltimore," "Philadelphia," "San Francisco," "Yorktown," "Concord," "Bennington," and "Petrel." At the time these ships were commenced naval architecture and engineering had advanced materially from the stage represented by the first group, and the new ships were fully up to the progress of the period.

The "Baltimore" and "Charleston" were built from plans procured abroad, and the "Philadelphia" and "San Francisco" were reproductions, more or less modified, of the "Baltimore's" design. The other vessels were designed by the bureaus of the department, and in them were introduced, wherever possible, the best features of the foreign ships.

Following these came two more ambitious vessels of between six and seven thousand tons, both armored, one called a cruiser and the other a battle-ship—the "Maine" and the "Texas." The "Maine" was begun in 1888 and the "Texas" in 1889. The plan of the latter was purchased in England. Both are creditable ships for their size, and will undoubtedly form a valuable part of our future navy.

Since the "Texas" the United States has bought no plans abroad. It has relied upon its own inventive and mechanical capacity. The number of ships begun includes five cruisers of the second class, two gunboats, and a practice vessel. In reference to these, no especial difficulty was presented to an establishment which had accomplished the results already described. Another armored ship of the "Monitor" type, the "Monterey," and a harbor-defence ram of peculiar design, are also well advanced in construction.

In addition to the above, the department has, in the last two years, undertaken the construction of vessels of an entirely novel character. They are experimental, not in the sense in which the "Chicago" and her contemporaries were experimental, because we now know what the shipbuilders and manufacturers of the country can accomplish; but they embrace in their design features so wholly individual and unusual as to represent a second departure in American naval construction.

The vessels of which I speak are of four types : first, Cruiser No. 6 ; second, the armored cruiser "New York" ; third, Cruiser No. 12, commonly known as the "Pirate," and her new consort, No. 13 ; and fourth, the three battle-ships, the "Massachusetts," "Indiana," and "Oregon."

Of Cruiser No. 6 there is not much to be said. She belongs to the recognized cruiser type, but her greater size permits an expansion in those qualities wherein the ordinary cruisers are most defective—coal endurance and sustained speed. Her coal capacity is 1,300 tons, which gives her a radius of action of 13,000 miles, a distance far beyond the average vessel of this type. The additional weight of her machinery enables her to reach not only the guaranteed speed of twenty knots, but a sustained sea speed of nineteen knots, which is certainly two knots above that ordinarily maintained by ships of her class. She has, in addition, unusual protection for her guns and a powerful battery. The main armament consists of four 8-inch and ten 5-inch guns,—fourteen in all,—while the secondary battery comprises twenty-four light pieces. She is a cruiser pure and simple ; but with her sustained speed and remarkable endurance, her powerful battery, and the armor with which she is protected, she is a cruiser of no ordinary character.

Next in order comes the "New York," an armored cruiser of 8,150 tons. The radius of action of the "New York" and her speed are the same as those of No. 6. Her battery is composed of six 8-inch guns, four of which are protected by barbettes and shields of heavy armor, and twelve 4-inch guns, while her heavy protected deck and armor in the wake of the engine spaces form additional defence. She is not only constructed to destroy commerce, but to destroy commerce-destroyers, and of these there are few who would be able to meet her on equal terms.

The "Pirate" and her sister-ship, Nos. 12 and 13, are of an entirely different type. They are fully protected against light guns, and their armament, comprising one 8-inch, two 6-inch, and eight 4-inch guns, with twenty rapid-fire guns, is a match for any armament that the converted commerce-destroyers of the day can carry. Armor protection they have also of a limited character, but their two essential features are coal capacity and speed ; the former gives them a radius of action of 25,000 miles, while the latter, developed by engines of over 20,000 horse-power,

propelling three screws, is placed at a maximum of twenty-two knots and a sustained average of twenty one. They can steam around the world without touching at any point for coal, and they can overtake with ease the fastest trans-Atlantic liner of the day.

Finally we come to the battle-ships. These vessels, which were adopted by Congress, after considerable opposition, at the recommendation of the department, are vessels built for the defence of the coast of the United States. They have been often described, and it is not necessary to repeat the description here. Their speed is high for vessels of this class. Their coal endurance is amply sufficient for the purpose for which they are designed. Their defensive protection is thorough and effective, their belt and redoubt armor being eighteen inches in thickness. As for their battery, the statement made six months ago, that it is the heaviest and most effective battery carried to-day by any ship afloat or projected, has never been disputed. Four 13-inch guns, rising to a height of eighteen feet above the water, eight 8-inch guns at an elevation of twenty-five feet, and four 6-inch guns distributed in various parts of the casemate, form the armament.

These four types of vessels are not imitations. They do not represent any specific class or model existing abroad. Points of resemblance they undoubtedly have, as all ships must have; but in their essential features they are highly individual in character, and in a way not to fall behind, but to surpass, the types they may be called upon to encounter. Perhaps it may be said that no one feature of these ships is unique, but the combination of features which they represent is admitted to be unique on all hands.

Until recently foreign critics have been silent as to the progress of our navy. Beyond an occasional newspaper paragraph little has been said about it, and that little has been of the most cursory description. Very recently, however, the subject has begun to engage attention, and the publication in England, in March last, of an elaborate and carefully-prepared paper, has called forth extensive discussion and awakened considerable interest abroad. This paper is entitled "Some Recent Warship Designs for the American Navy," and was read in March last before the Institute of Naval Architects by Mr. J. H. Biles, a member of the council of the institute and a naval architect of

experience and wide reputation, who had recently returned from a visit of inspection to this country. The essay was followed, at the time, by a long and animated discussion, in which many English naval critics took part.

In order that we may "see ourselves as others see us," it may be well to quote from Mr. Biles's paper some of his comments. It begins with a description of the first four ships of the new navy, the "Chicago," "Boston," "Atlanta," and "Dolphin," and takes in all the important constructions authorized since 1882, including the latest. Considering the state of the art of steel ship-building in America in 1883, it is satisfactory to hear Mr. Biles declare that, in respect to workmanship, "the American ships are quite equal to the best of the English."

As might be expected, Mr. Biles gives special attention to the four types designed since March 4, 1889, which have been referred to above. Of Cruiser No. 6, a vessel of 5,500 tons' displacement, he says:

"The nearest vessels of our navy to this are the belted cruisers, which have armament inferior by two 8-inch guns, and a speed of a knot an hour less. The 'Reine Regente,' in the Spanish navy, is of considerably less displacement, has a thicker protective deck on the flat; but, while she has four 9-inch guns against the four 8-inch guns of this vessel, they have not as good protection, and she has only six 5-inch guns against ten."

Of the "New York"—armored Cruiser No. 2—he says:

"The 'New York' is rated by the Americans as an armored cruiser. She is of a type somewhat between our first-class cruisers of the Edgar class and the 'Blake 'and 'Blenheim,' being practically of the same length and breadth as the latter."

Mr. Biles continues:

"Compared with the Edgar class, this vessel is much more powerfully armed and much better protected. Her sustained sea speed will probably be greater."

Of Cruiser No. 12, whose design, as already stated, is to be reproduced in No. 13, he says:

"No. 12 Cruiser is, however, the most important of the cruisers. She is called a 'commerce-destroyer,' and is popularly known as the 'Pirate.'"

He then gives a table in which he contrasts the speed of the "New York," No. 6, and No. 12 with the fastest British ships, the "Blake" and "Blenheim," from which he concludes that the

American "Pirate" will be a knot and one-half faster than the fastest English ship, and adds:

"From this table it will be seen that our fastest ships will probably be slower than the American fastest ships. In the case of Cruiser No. 12, the fastest American ship, this result will have been attained by giving her a length greater than any warship built or building, by giving her a light armament, thus reducing the crew and all their accompaniments, and by simplifying the structure and arrangements generally. Speed and coal endurance are the features of this vessel which have been specially intensified, and Mr. Secretary Tracy's conception of what is required to destroy commerce seems to have been well worked out by the constructive staff. . . . The building of such a ship as No. 12, which we have nothing to cope with, certainly is an indication of what America is capable of, both in conception and construction, and I have thought it of sufficient interest to lay before this institute for consideration and discussion."

The most important vessels in the new navy, in the opinion of this accomplished English expert, are the three coast-line battleships, "Massachusetts," "Indiana," and "Oregon," having a displacement of 10,298 tons each; and he gives an instructive table in which the general characteristics of these ships are contrasted with those of the eight new battle-ships now under construction in England, each having a displacement of 14,150 tons, and the "Camperdown" and "Anson," of the English navy, with a displacement of 10,650 tons, and the "Sinope," of the Russian navy, of 10,800 tons.

The armament of the three American battleships he describes as follows:

"The armament consists of four 13-inch 35-calibre guns, mounted in two turrets formed with inclined armor 17 inches thick, the horizontal thickness being 20 inches, as shown in Fig. 23. The bases of the turrets are protected by redoubts 17 inches thick, extending from the top of the armor belt to 3½ feet above the main deck. These guns can be loaded in any position.

"In addition to these there are eight 8-inch guns mounted in four turrets as shown in Fig. 24. These turrets are formed of inclined armor 8½ inches to 6 inches thick, which is equivalent to from 10 inches to 7 inches horizontally. These turrets are placed on a deck above the level of the 13-inch guns.

"There are also four 6-inch guns, protected by 5 inches of armor, having 2-inch splinter bulkheads worked around the deck, the ammunition being served up inside these bulkheads. There are twenty-eight small rapid-firing guns and six torpedo tubes. The conning tower is 10 inches thick. The 13-inch guns are 17 feet 8 inches above the water, and 6 feet above the deck over which they fire. The 8-inch guns are 24 feet 9 inches above the water, and the 6-inch guns 14 feet 10 inches. The 8-inch guns can fire over the tops of the 13-inch, and ior considerable angles across the middle line of the ship. With such a large armament, the question of the supply of ammunition is a most important one, and seems to have been very well worked out. Each gun has

its own magazine almost directly underneath it, below the belt-deck, and therefore protected by thick armor, so that there are no ready-use magazines in comparatively unprotected positions.

"The engines are 9,000 horse-power, and a maximum speed of 16¼ knots is expected, and a sustained sea speed of 15 knots.

"The coal-bunkers will stow 1,800 tons of coal. The estimated radius of action at 10 knots with this supply of coal is 16,000 miles. The (normal) supply of coal (or the quantity of coal that could be carried on the trial trip) is 400 tons."

Mr. Biles adds:

"The armament of these vessels seems to be more powerful than that of any European battle-ship. . . . Of course, in order to attain this result, something has had to be sacrificed; or rather something is not existent in these ships which exists in the larger ones. (The English battle-ships are 14,150 tons' displacement.) The speed estimated, compared with our latest battle-ships, is probably about one and a quarter knots less. The (normal) coal supply (or quantity to be carried on speed trials) is 500 tons less."

Mr. Biles further states:

"As these vessels will probably have to act very much nearer their base than European vessels, their bottoms will probably be in better condition, so that the real speed would not be much, if any, less. For the same reason their coal supply need not be so large, and therefore it would seem that their preponderance of armament would give them an advantage in a combat near their own coast-line with any European vessel. They are distinctly superior in most respects to any European vessels of the same displacement, and for the purposes intended, of protecting the American coast-line, they seem to be quite a match for any ships afloat."

It will be seen from these extracts that Mr. Biles has little to say of the American designs except by way of commendation. It is worth while, however, to turn to the other side of the picture, if it has another side, and see how far, in the discussion which the paper raised, the new designs have been made the subject of adverse judgment. It is right that the American public should know, and, above all, that they should rightly estimate, the criticisms to which the work of their naval constructors is subjected; that, if the objections that are raised to this work are valid, they should understand it. But, on the other hand, it is equally important that they should not be misled by errors of statement into the supposition that the new navy is not all that their fancy painted. The opinion of foreign critics is only valuable as throwing a side-light upon our labors. Apart from this, it is a subject neither of congratulation nor of concern.

The principal criticism called forth by the paper read before the Institute of Naval Architects is contained in an editorial

article in the London *Times* of April 6, which reproduces closely the general comment made by Mr. White, the chief constructor of the English Admiralty, in the discussion which followed the reading of Mr. Biles's paper.

"For some time," says this article, "they [the United States] were content to import their designs for warships from Europe. Even now there is, we believe, no American warship actually ready for sea which was not built from European designs or imitated from existing European patterns."

But it also declares that the Americans

"are now dealing independently, and, as it seems to many, rather too boldly and light-heartedly, with the problems which have long engaged ourselves. Our own extensive experience, and our frequent disappointments with the contrast between expectation and reality, between theory and practice, between calculations on paper and realized results at sea, have perhaps made us a little more cautious and distrustful at innovation than it behooves an inventive and ingenious people like our American cousins to be. If the greater boldness of the American designers is really based on sound judgment, and not merely on lack of experience, we need not regret it. We shall in the long run profit equally by their experience, whether it results in failure or in success."

What the *Times* characterizes as the "boldness and novelty" of the new American designs are the logical result of a decision to adapt the designs of ships of the American navy to the necessities of our situation. What is a good ship for England or France is not necessarily a good ship for the United States. Nor would it be in any sense a praiseworthy feature of American designs that they were only a slavish imitation of European models. England has colonies and dependencies in every quarter of the globe, and her commerce must be protected in every sea. Her battle-ships are designed to cross oceans and to maintain an offensive warfare at distant points. American battle-ships were not designed to cross oceans, but are for the protection of our own shores and coastwise cities, as their name implies.

The criticism made of the battle-ships has been confined to two points: first, their apparent lack of coal endurance, and, second, the arrangement of their batteries. As to the first point, the American ships are designed to carry only 400 tons of coal at the load-line, whereas English designers give 900 tons to ships of similar type having a displacement of 10,000 tons and upwards. Great stress is laid upon this supposed lack of coal endurance in our battle-ships, notwithstanding the fact that they have a bunker capacity for 1,800 tons. The coal endurance of a ship is deter-

mined by the capacity of its bunkers. As coal endurance is estimated, our battle-ships have a possible radius of action of 12,000 miles—much greater than any battle-ship of Europe. The quantity of coal to be carried will be regulated by the immediate service to which the ship is to be put. With 600 tons on board, the top of the armored belt will be two feet six inches above the water-line—exactly the height of the belt of most European battle-ships of 10,000 tons' displacement.

Now, in adjusting the "antagonistic elements" of weight, of battery, of armor, coal endurance, and speed, all constructors accord to each the weight best calculated to accomplish the purpose for which the ship is intended, keeping in mind that only so much weight can be put on board a ship of given displacement, and that its offensive and defensive power is the result of the adjustment of these more or less antagonistic features. The department in its recent designs has given especial prominence to what in each type was deemed the most important feature, mindful that it must sacrifice those that are of less consequence.

The first and chief characteristic of a battle-ship should be its ability to destroy its adversary, and this depends on the strength of its armament. The second should be its ability to prevent being destroyed, and this depends on the strength of the armor with which its hull and battery are protected. The third feature should be its speed, and the fourth its coal endurance. These last are necessarily subordinate features. Acting near the base of supplies, it would be useless to load the bunkers of our ships with 900 tons of coal, the usual allowance to English battle-ships of a similar size. We think it better to take 500 tons from coal and put it into armor and armament. A further saving of weight lies in our moderate freeboard. Steering a middle course between the low hulls of the original monitors and the towering proportions which have been attained by an extravagant reaction from that system, resembling the great four-story structures of three centuries ago, we have placed our 13-inch guns eighteen feet above the water-line, to enable our ships to fight bows on in almost any sea, while above them are the 8-inch guns, twenty-five feet from the water, which could be fought in a hurricane. Economizing weights in these two respects has enabled our constructors to give to our battle-ships a battery more powerful and more efficient than that of any ship yet designed or afloat.

That we have succeeded in this respect is not denied by any of our critics, while, at the same time, we have thickness and strength of armor, giving the ships defensive power substantially as great as that of the "Royal Sovereign" class, the latest product of English designs in battle-ships.

The second criticism on the battle-ships relates to the disposition of the guns. "English designers," said Mr. White, "laid most stress upon the risk of interference." "It was specially arranged that one part of the armament should not be able to obstruct the use of another." Mr. White expresses doubt whether this rule has not been disregarded in the arrangement of the batteries of the battle-ships, and *The Times* says:

> **"The enormously powerful and varied armament is so disposed that, according to Mr. White, the very serious danger would be incurred of the fire of some of the heavy guns interfering with that of others."**

Upon this question of interference the English critics are singularly in error. The salutary rule referred to by Mr. White has not been overlooked by the American constructors. The batteries of our battle-ships, powerful and varied as they are, are so arranged that the fire from no one of the large guns will interfere in the slightest degree with that of the others. Nor will the vicinity of the turrets of the 13-inch guns, as *The Times* appears to think, prevent the efficient use of the 8-inch guns on the upper deck.

The maximum fire with all the guns is permitted on the broadside.

All guns that are mounted to train directly fore and aft, from either bow or stern, have this fore-and-aft fire; and in addition to this capacity, the 8-inch guns on what may be called the off-side may be trained five degrees across the bow. Removable tops or breaks are placed to prevent a greater train than this; but should the commander desire to direct the off-side 8-inch guns to fourteen degrees on the fighting side for an emergency, this could be done, and no danger would result if the precaution were taken, for this given round of emergency, to remove the observers from the conning tower.

The mounts are so arranged that the depression ceases at five degrees in the 8-inch guns, which absolutely prevents any interference of fire at any train with the 13-inch turrets. The subject of interference of fire was thoroughly considered, and all its bear-

ings understood and appreciated, in laying down the battery plans of the vessel.

To resume: there is an arc of but eight degrees for 8-inch guns on the off-side, that is, the non-fighting side, of the ship, which, without precautions, it would be undesirable to utilize. The whole of the remainder of the train is at the disposition of the commander.

The arrangement is such that one of these ships will be able to deliver a bow or stern fire of two 13-inch guns and four 8-inch guns, throwing 3,200 pounds of steel at every volley, while, as is stated by a Philadelphia correspondent in the same number of *The Times*, "in a single broadside volley there will be over two and one-half tons of metal, and in the first ten minutes of an engagement one ship will hurl 28,400 pounds of steel."

To account for the success of the American designers in placing upon a ship of 10,300 tons a heavier battery than English designers had placed on a ship of 14,150 tons, and substantially as heavy armor, it has been surmised that the American constructors had used lighter scantling, producing lighter and weaker hulls. But a reference to the detail drawings will show that this surmise is entirely without foundation, and that the American hulls, instead of being lighter, are actually heavier than those of the English battle-ships. To illustrate: the most important of scantlings, namely, the thick outside plating below the outside armor, which includes all the under-water part of the ship, is of the same thickness on the American vessels as on the "Royal Sovereign," a vessel of nearly 4,000 tons' greater displacement, and is from one and one-half to two pounds heavier per square foot than on English battle-ships of 10,600 tons' displacement.

Another surmise offered in the discussion before the institute to explain the American solution of the problem of weights was that we had probably reduced the quantity of ammunition below the European allowance. This is also an error, although, in view of the field upon which these ships are to operate, it might have been safe to reduce somewhat the quantity of ammunition. As a matter of fact, the number of rounds for the large guns is about the same as that allowed on battle-ships abroad.

Turning from battle-ships to cruisers, we find that criticism proceeds from the same narrow stand-point. It fails to consider that Americans, in building cruisers, as in building battle-ships,

have followed the universal rule that the ship must be adapted to the situation and the service in which she is to be used. For our own purposes, therefore, we have improved upon the designs which, to quote the London *Times*, we have hitherto "been content to import from Europe."

Cruisers can be regarded as part of the fighting force only in a restricted sense. They are the eyes of the fleet, and are intended to watch the enemy. They serve somewhat the purpose of cavalry in a land force, not only as scouts, but for rapid movements at different points to worry and harass the hostile fleet, and to make sharp and rapid raids chiefly upon his commerce. If the United States should be engaged in war, these cruisers, in order to reach the most important lines of commerce, would have to steam some three thousand miles from our own shores. For this purpose cruisers built upon European plans would be of little or no value. The "Baltimore" and the "Philadelphia," the designs of which, as *The Times* says, were "imported from Europe," have an estimated coal endurance of 9,000 miles, but in actual practice not more than 7,000 miles. Sent out in time of war to attack one of the lines of an enemy's commerce, these cruisers would no sooner reach their destination than they would be compelled to start on their homeward voyage. Their endurance is not sufficient for them to remain even a week in their field of operations. It is for this reason that in our recent designs which have not been imported the purpose has been to increase very largely this element of coal endurance.

Cruiser No. 6, whose contract speed is twenty knots for four hours in the open sea, carries 400 tons of coal, at the designed water-line, but has a bunker capacity of 1,300 tons, which gives her an estimated endurance at ten knots, with full coal supply, of 13,000 miles. The "New York," having the same speed, carries 750 tons of coal at the designed water-line, and has a bunker capacity of 1,500 tons, giving her an estimated endurance, under similar conditions, of 13,500 miles. Finally, protected Cruiser No. 12, whose contract speed is twenty-one knots for four hours in the open sea, and which carries 750 tons of coal at the designed water-line, and has a total bunker capacity of 2,000 tons of coal, has an estimated endurance of 25,000 miles. Possibly the radii of action claimed for these vessels will not be fully realized in actual service. In estimating coal endurance, it is assumed that the coal is perfect, that

the sea is smooth, and the bottom clean. But as these conditions are rarely attained on board a ship in commission, the radius of operation of a vessel must necessarily contain a speculative element.

Basing our estimates, as we do, upon quantities of coal consumed per indicated horse-power per hour, similar to those adopted in calculating the endurance of contemporary English designs, the estimates are valuable as furnishing a comparative statement of the endurance of different ships, although it would seem that the Americans, in their estimates, have reduced materially the probable error. In the case of the "Blake," for instance, with 9,000 tons' displacement, and a coal capacity of 1,500 tons, her endurance at ten knots is estimated at 15,000 miles, while the "New York," having a coal capacity of 1,500 tons, and a displacement of 8,900 tons with that amount of coal on board, has an estimated endurance of only 13,500 miles. While the English proceed upon the theory that one ton of coal will drive the "Blake" ten miles at ten knots' speed, we only claim for our estimate that one ton will drive the "New York" nine miles at the same speed. The greater accuracy of the American figures is shown in a still more marked degree by a comparison of the "Blake" with Cruiser No. 6. We estimate that Cruiser No. 6, with 1,300 tons of coal on board and then having a displacement of 6,400 tons, will have an endurance of 13,000 miles, while the English claim for the "Blake," carrying 1,500 tons of coal and having a displacement of 9,000 tons, an endurance of 15,000 miles. It thus appears that for a 6,400-ton ship we allow the same amount of coal per mile that the English allow for a vessel of 9,000 tons. In the case of No. 12, we have an additional advantage in the economical working of the third screw, as a result of which, in ordinary cruising, it will only be necessary to use a single engine, and the consumption of coal will, therefore, be less than in any twin-screw ship of the same design.

Until, however, actual experience has been had under many and varied circumstances at sea, neither nation will be able to predict with accuracy the coal endurance of its ships of war. Even in the matter of speed *The Times* believes that the "Blake" will have the advantage over No. 12. The contract for No. 12 requires that she steam in the open sea for four hours at the rate of twenty-one knots, with a pressure in her fire-room not exceeding

an average of one inch. The estimated speed of the "Blake" with forced draught over a measured mile in smooth water is twenty-two knots. Judging from the results of trials made under these two different conditions, an Englishman would be forced to admit that for continuous steaming at sea the probable advantages would be all on the side of the American vessel.

If the bunkers of No. 12 are filled with 2,000 tons of coal, her displacement will be 9,000 tons, exactly that of the "Blake" carrying 1,500 tons of coal. The designs and workmanship being equal, the speed of the ship may be roughly estimated by the weight of her boilers and engines. These in No. 12 weigh 300 tons more than in the "Blake," while the boilers have a heating surface of more than 45,000 square feet, as against 33,000 in the English vessel. The American vessel is also thirty-seven feet longer and has seven feet less of beam. Therefore if Cruiser No. 12, even when carrying a third more coal, is not a much faster ship than the "Blake," all the theories of naval architects and modern engineers are entirely at fault.

But the most remarkable error found in the editorial of *The Times* remains to be considered. The article says: "There are, moreover, other estimates of a highly speculative character in the American calculations of the speed and coal endurance of their ships. The area of heating surface allowed in the designer's estimates for each unit of indicated horse-power is considerably smaller in the American calculations than the area adopted by the Admiralty as the result of practical experience." As the area of heating surface allowed by the designers for each unit of indicated horse-power is an important factor in determining the ability of a ship to maintain her speed at sea, it becomes important to ascertain whether *The Times* is correct in this statement. Looking into the question, we find that the area of heating surface for each indicated horse-power in the (three) English ships is as follows:

ENGLAND.	Indicated horse-power.	Heating surface.	Ratio.
"Blake"	20,000	34,000	1.650
"Edgar"	12,000	20,000	1.667
"Latona"	9,000	16,000	1.777
Belted cruisers	9,000	15,900	1.767
	8,650	16,055	1.856
"M" class	9,000	14,000	1.555
	10,000	14,000	1.400
"Archer" class	3,850	5,900	1.532
"Anson" and "Benbow"	11,700	20,244	1.730
"Nile" and "Trafalgar"	12,800	19,390	1.515
"Victoria" and "Sans Pareil"	14,350	20,000	1.394

In the latest American designs we have the following:

UNITED STATES.

	Indicated horse-power.	Heating Surface.	Ratio.
"New York"	16,000	33,120	2.070
No. 6	13,500	28,299	2.096
No. 12	22,000	45,341	2.061
No. 13	22,000	49,150	2.234
"Newark"	8,868	16,736	1.887
"Yorktown"	3,398	8,092	2.381
"San Francisco"	9,913	20,134	2.031
"Charleston"	6,666	15,577	2.337
"Philadelphia"	8,815	20,458	2.321
"Concord"	3,404	8,092	2.377
"Vesuvius"	3,795	8,981	2.366
"Baltimore"	10,065	17,175	1.707

From the above table it appears that, with the single exception of the "Baltimore," every one of our latest designs has a higher ratio of heating surface to indicated horse-power than appears in any of the English ships referred to, and the "Baltimore," being of English design throughout, might properly go into the English column. This high ratio of heating surface means less work for each square foot, and consequently greater endurance and longer life for the boilers, and it effectually disposes of *The Times's* criticism.

It is not, however, necessary to pursue further the study of our neighbors' comments. Most of them which are adverse in character are clearly based upon a misconception of the facts. If our European friends insist upon underrating the qualities of our naval vessels, it is a thankless and unnecessary task to undeceive them. Some of them have made similar mistakes before, and have found out their error only after bitter experience. But it is important that the operations of the Navy Department, inviting the intelligent scrutiny of every citizen, should not be misconstrued by our own people through any inaccuracy of statement.

B. F. TRACY.